

ADDRESS OF THE PRESIDENT.

Lieut.-Col. H. H. GODWIN-AUSTEN, F.R.S., etc.

Delivered 10th February, 1899.

LADIES AND GENTLEMEN,

The Address of your first President, Dr. Henry Woodward, contained, as he happily termed it, "a haul of the naturalist's dredge," and enumerated in chronological order the progress of marine exploration, both private and public, the outcome of many cruises, initiated by our own and foreign nations, to investigate the fauna of the deep sea; and he followed this by several pages of the interesting results, with valuable suggestions as to the distribution of certain forms in time and space.

Your second President, Dr. G. B. Howes, has on two occasions, in 1895 and 1896, taken as his subject the progress of malacological science, during the short existence of our Society, in the field, the museum, and the laboratory. In these two Addresses Dr. Howes' large and varied knowledge not only of the literature on the subject, but of the great work in progress, is shown on every page. I feel it a difficult task to follow so talented a predecessor in this chair. He stands on a platform of biological inquiry which I, although keenly desiring to explore it closely, can only survey from a distance. Hence I cannot hope to cover so wide a field, full of fresh discovery and suggestiveness. My sphere of labour has been in India, an area large in itself, but small when compared to the rest of the world; my researches have been confined to the land and fresh-water mollusca, and as a field collector to only a portion of our Indian Empire. My duties carried me for years to the high mountains of the country, never to the seaboard, so that my knowledge of marine shells is restricted to such fossil forms as I had opportunity now and then to collect.

A short account of the Indian workers in this branch of Natural History may be of interest. Excluding the European conchologists, Pfeiffer, Cuming, etc., who described single species, or collections, from the East, brought or sent home at various times, with the localities often very ill-defined, according to our present ideas and requirements regarding distribution, the work of conchology in our Indian possessions does not go back very far in time. The first systematic collectors of land-shells were Capt. Thomas Hutton, of the 37th Regiment of Bengal Native Infantry, and Mr. W. H. Benson, of the Bengal Civil Service. Hutton's first contribution is to be found in the Journal of the Asiatic Society of Bengal, entitled "Notices of some Land and Fresh-water Shells occurring in

Afghanistan." He was with the Army of the Indus that advanced into that country in 1839, and the collection was made between Dadur in Sind, to Girishk on the Helmund, crossing the Bolan Pass.

This is a country fresh in our memories; another army has gone into it and returned, but we know very little more of its land mollusca. Officers of the Army, interested in any branch of Natural History, are as rare in these days as they were in Hutton's time. I can only name one man, Mr. M. T. Ogle, an old Survey Assistant of my own, who brought back any shells from Afghanistan. Except when on actual service in face of an active enemy, no men have better opportunities for research than officers of H.M. Army. Days, weeks, even months, are spent by many in the most favourable places in the world, where Nature is lavish of her gifts, where the monotony and solitude of the life are to some temperaments almost unbearable; in such a quarter, if they only possessed an interest in some branch of science, their lives would at once be full of pleasure, and the sameness of the daily military duty would not be felt. It is no excuse to say there is no time, or that duties would be neglected; the lives of such men as Sir Henry Rawlinson (and many others can be recalled) show what can be, and has been, accomplished by our race in every part of the world, even when fully employed departmentally.

Benson, to whom Hutton sent most of his shells, and with whom he was in constant communication, began work about the year 1834. In August of that year he exhibited, at a meeting of the Zoological Society of London, a collection of land and fresh-water shells formed in the Gangetic Provinces of India. It comprised forty species, which he presented to the Society, and it would be interesting to know what eventually became of them. His paper was an important communication, and followed a previous one in 1832 to the Asiatic Society of Bengal, on a collection presented to that Society from the same part of India. The animal of a *Macrochlamys* was described for the first time, and even reached this country alive.

From this period Benson was an enthusiastic worker, and it may be truly said that he laid the foundation for the study of Indian terrestrial and fluviatile mollusca on a thoroughly scientific basis. More important too, for his time, he was imbued with that proper appreciation of geographical distribution, without which so much of the value of malacology as a science is lost. His descriptions are most accurate, and his remarks and conclusions often of great interest. By his excellent example he gathered about him a number of men in the service of the Hon. East India Company, who followed in his footsteps. We find among these some, whose names are household words in Indian Natural History; others, full of future promise, fell in the service of their country; whilst a few yet survive. The following is a list of such of these early workers whose names most deserve to be recorded and recalled to memory, since we are indebted to them for contributions towards our present studies, and many of their names will be familiar to you in nomenclature, though the individual naturalist or collector is known but to a few:—Major

Alexander, Dr. J. F. Bacon, Col. W. G. Baker, Sir David Barclay, Col. R. H. Beddome, Capt. C. A. Benson, Dr. W. Bland, R.N., Capt. W. T. Boys, Lieut. Burkinyoung, Dr. Theo. Cantor, J. Chesson, Lieut. W. G. Cox, Dr. Francis Day, Rev. S. B. Fairbank, Major FitzGerald, Col. Robert Gordon, A. A. Gould, Capt. J. C. Haughton, Dr. Helfer, Dr. R. Hungerford, Col. Jenkins, Dr. Jerdon, E. L. Layard, Hugh Nevill, Dr. J. T. Pearson, Jas. Prinsep, Dr. Rawes, Major Rowlatt, Capt. Sankey, R.E., and Mrs Sankey, J. Doyle Smith, Sir E. Tennent, Dr. Thomson, Dr. Traill, Robert Trotter, and Dr. Walker.

I began collecting seriously in 1862, and my first small gathering, made near Skardo in Little Tibet, was sent home to be named by S. P. Woodward.¹ At this time Captain Thomas Hutton, who had retired and was residing at Jellapahar Mussoorie, was the first officer I met, after ten years in the country, who possessed a library, with the exception of Dr. Verchere, a geologist, who took an interest in natural history. I owe a considerable debt of gratitude to Hutton for the loan of books and for assistance in naming some of the first species I got together in the N.W. Himalaya. The remains of his own collection he had about this time sent to a married sister, living in Australia, and it would be interesting to know what eventually became of these, since they included so many species identified with both Hutton's and Benson's labours. A great stimulus to Indian conchology and science generally was given when the Government of India established the Geological Survey Department in 1851. Dr. Thomas Oldham was selected Superintendent, and as the work expanded it was followed by the appointment of Assistants, men with scientific training, acquired either on the home surveys, or at the School of Mines. Most of the Assistants on the Geological Survey began to collect and publish the results. T. Oldham, W. Theobald, W. T. Blanford, H. F. Blanford, W. King, R. B. Foote are conspicuous for the work they have done; they were followed later by F. Stoliczka and V. Ball.

The formation of the Indian Museum and the transfer to it of the valuable collections formed under the care of the Asiatic Society of Bengal, accompanied by the appointment of Dr. J. Anderson as Superintendent, with Geoffrey Nevill as an assistant, was a further stimulus to our particular branch of Natural History.

I have mentioned Ferdinand Stoliczka, and I am safe in saying that some of the most valuable papers on Malacology were published by him. It had been his intention to work out the whole of the land operculated genera. Alas! he never lived to accomplish this. He was appointed Geologist and Naturalist to the Yarkand Mission, and on the return journey, up on the Karakoram Pass, he succumbed to the effects of the great altitude, and science lost a most gifted and promising disciple.

Thus it was that from about 1856 onwards there existed in India a small band of naturalists, devoted to the collection and study of

¹ Proc. Zool. Soc., 1864, p. 388.

its recent mollusca, as the many papers published at this period testify.

It was my good fortune to become associated with several of these naturalists, whom I may call fellow surveyors, and to form many lifelong friendships. The association particularly with Henry F. and W. T. Blanford, Ferdinand Stoliczka, and Geoffrey Nevill, I can well say has brightened my life, and led to a more profitable use of many hours of that life. It gave a stimulus to research when in the field, and enlivened days of solitude when extending the survey of India into the then unknown districts of its Eastern Frontier.

I feel now another pleasure in the satisfaction that I was able, in my turn, to import new interests into the lives of others, my assistants on the Eastern Frontier Survey, that I know rendered their work more pleasurable, and made it something more than the daily use of the theodolite and plane table. Among these I may mention M. T. Ogle, W. Chennell, both of whom eventually died from the exposure and hard work they underwent, W. Robert Belletty, Captain Badgley, and last, and my latest contributor in Burma, Colonel R. Woodthorpe, R.E, the news of whose sad death in Calcutta has only reached me since I began to write this address. As collectors in Ornithology, Entomology, and particularly in Conchology, these assistants greatly distinguished themselves.

On being transferred from Kashmir and the N.W. Himalayas to the Eastern Frontier, I soon learned what a veritable mine of wealth in land-shells this part of India presented. I shall not readily forget my first arrival in 1865, at the base of the Khasi range at Teria Ghat, with its great profusion of animal and plant life, amid scenery so well described by Sir Joseph Hooker in his "Himalayan Journals." Every condition suited to molluscan life is there extant. A humid atmosphere, limestone rocks, or rich vegetable mould, a shady forest, with a luxuriant growth of mosses, ferns, bamboos, and palms. Species of many genera were there seen by me for the first time, and in abundance—the large, finely marked *Cyclophorus*, the hairy *Spiraculum*, the glassy *Pupina*, curiously formed *Alyceus*, delicate *Diplommatina*, and minute pink *Georissa*, with many an interesting form of *Helix*. It is not surprising that in such a field I continued to collect, and since that time it has been my endeavour to extract something useful out of the materials I got together, and the opportunities for observation then afforded to me. The result is my position here this evening, for the honour of which my thanks are due to you. I can assure you that I often feel I did not make all the use of the opportunities that presented themselves. I wish I possessed the magician's power to transfer myself to many similar, even richer spots, I can recall, and in the capacity of guide see some of the younger working members of this Society gathering in what would there await them, and I feel sure many would not object to be my fellow-travellers on such an expedition.

I must return to Teria Ghat: it teaches us something, viz., that the molluscan fauna, even in what may be called a well explored part of

India, has not yet been by any means exhausted, especially as concerns the minute forms, such as *Pupa*, *Acmella*, *Paludestrina*, etc. These live on the moist green surface of the rocks, or on the mossy ledges, but only during the rains. When I tell you that from the neighbourhood of one place, Cherra Punji, I only succeeded in finding two such species, and one of these I sought for in vain a few years afterwards, how many must remain to be discovered in the successive deep gorges east and west of Teria, 130 miles on one side to the Garo Hills and 150 miles to the Naga Hills on the other. The heat, the drenching rain, the necessary exposure, and the insalubrity of some of these valleys during the summer months render them almost inaccessible, except to a most keen and strong collector. The rainy season is also the best time for seeking the slug-like forms, of which several must remain to be discovered. Such a form lives on the south end of the Cherra Plateau, near the great cave. One day in the month of June, when with a party of Khasias forcing our way through the dense scrub to the mouth of the cave, I took off a leaf a slug of a genus which I had never seen before. During the transfer to a box it was dropped into the undergrowth, and could not again be found, and although further search was made as we proceeded, I never succeeded in finding another.

How often it is that species one year most abundant are not obtainable the next. Benson's account of the discovery in 1842, at Moradabad, of *Camptoceras terebra* is a good example; in 1843, in the same piece of water which had once formed the bed of the Ram Ganga River, only three specimens could be found; in 1845 none could be seen at all. This genus was not again met with until 1869, when I discovered one morning in a marsh in the Maimensing District, near the base of the Garo Hills, not only one, but two species, which were described by Henry Blanford as *C. Austeni* and *C. lineatum*. This spot is 760 miles from Moradabad. No one has ever taken them since, yet the genus must be, I feel convinced, a common one, of which other species probably will some day be discovered. It is still more interesting to relate that this genus, so little known even at the present time, was found fossil by Mr. Shrubsole about 1880, in the Eocene beds of Sheppey, and the species was identified, described, and figured by me as *C. priscum*. This is a remarkable fact in the distribution of a genus in time and area. With such a gap to bridge over it should make us very careful in drawing conclusions regarding the original development and course of distribution of animal life, and its range in time. We have to bear in mind as well the extreme paucity of the material we have to work with, limited to so few genera, no fossil evidence at all in the majority of them.

This leads me to draw attention to the work that yet remains to be accomplished, not only among living forms, but their fossil predecessors, and how little has yet been effected. Take, for example, the mammalian fossil beds of Miocene and Pliocene age, perhaps better known as the Siwalik Series, tilted and faulted, compressed against the base of the Himalayas, and skirting the Sulaiman Range to Baluchistan. These beds are of enormous thickness, and present in places land surface after land surface,

separated by sedimentary deposits, and indicating conditions similar to those now obtaining in the same part of the world. I once had an opportunity, on a spell of leave with nothing else to do, of closely examining these deposits near Nahun, and I very soon discovered beds containing fresh-water shells, belonging to the genera *Unio*, *Bythinia*, and *Vivipara*. When digging out inch by inch the pelvis and hind leg of an elephant, associated with Chelonian remains, which were embedded in a thick bed of dark clay, several specimens of *Ampullaria* were found. Now these I should not have noticed under an ordinary passing inspection of the supposed face of the deposit, and it showed me that a close examination of such clay beds, digging them out and working over the material with a lens, might yield important results, and disclose minute species of not only fresh-water but land shells also: in such beds, indeed, *Camptoceras* might even occur. Similarly, on an exhaustive search, there is much, I am sure, to be yet found in the later Pliocene deposits of the Valley of Kashmir, which rest against the northern slopes of the Pir Panjal range. These beds are of great thickness, presenting at intervals old marsh and lacustrine surfaces, to obtain a better knowledge of the ancient fauna of which would be most valuable. I noticed that the fresh-water shells in these beds were very frequently flattened out by pressure, and compression of this kind may be one of the reasons for the paucity of fossil land-shells. Unless quite filled with fine silt they would certainly be broken, and closely coiled species would fill up very slowly.

These Pliocene beds, capped by the later Karewah deposits, extend round the Kashmir Valley for sixty miles from the south to the west and north-west, with a maximum breadth of fifteen miles. At Hirpur, which is 2,500 feet above the Jhelum River, I estimated the whole series to be 1,400 feet thick. I could only spare one afternoon for an examination of this spot. The shells were like existing species, an acuminate *Lymnea* and a small *Planorbis*, the latter the more abundant; impressions of a bulrush were very common, and a few small fish scales were detected. These occurred on two horizons, separated by 65 feet of coarse sands and coarse conglomerate. It is evident there is further work to be done here, open to future travellers. Mammalian remains might also possibly be found, but the teeth, or bones, of a *rakhsus*, or demon, were never reported to me in Kashmir, though such relics are well known to the natives in the neighbourhood of Jammu and Aknur, for there they say was the field of a great battle between demons. Rhunbeer Singh, the Maharajah of Kashmir, had one brought to show me when I paid him a visit, and we had a long and amusing discussion. I tried to show him it was the molar of an elephant, but he would not be convinced.

I should not expect to find many land-shells preserved in these deposits, for they are by no means common in the Kashmir Valley at the present day. *Bulimus candelaris* is perhaps the commonest shell, but very local. There is still much to be done even in this part of India. Stoliczka collected here on his way to Yarkand, while Theobald paid the valley a hasty visit in 1877, at the dry time

of the year. Some twenty species have been recorded, but the limit of the range of many has yet to be determined. Theobald's list¹ of sixty-four species includes shells from Murree, the base of the outer hills of the Punjab, and even far out into the plains.

To give some idea of the present land molluscan fauna of the North-West Frontier, I have listed out all the species hitherto recorded, separating those north of the Pir Panjal axis of elevation from those of the south side, Murree and the Punjab frontier. As regards this part of India, the first list (Appendix A) shows that the majority of the genera and species are European and Central Asian, with the exception of a few species of Zonitidæ which have passed over into this area. Species of this purely Oriental group are not numerous; only five genera, represented by as many species, occur. Three of these were found at Sonamurg, at the head of the Sind Valley at 10,000 feet, where the cold of Winter is even at the present day extreme, and deep snow covers the ground for many months. During the Glacial Period this valley was filled by a glacier forty miles in length, the terminal end of which was only about five miles from the Plain of Kashmir, so the present extension up and occupation of this part of the Sind Valley by these genera can only date from the decline of those conditions. The Valley of Kashmir in early Post-Glacial times was, I am led to think, quite open, with a temperate climate; and as representatives of these genera are now found living in the Jhelum Valley, at Murree, etc., their original and Pre-Glacial extension was from that southern side. Thus we may infer that a long and gradual exposure to cold conditions has rendered members of a tropical group able to contend with, and exist through, a long, rigorous winter. It would be also interesting to know whether any species of the Zonitidæ occur at a similar altitude in the main valleys of Maru Wardwan, which were also for many, many miles of their course once filled with ice, and how far exactly such species do extend. The same information is wanted on the Chenab and Sutlej Rivers. In Kashmir not a single operculated land-shell is recorded;² two or three of the Helices are well-known N.W. Himalayan forms. The second list (Appendix B) is a fuller one as regards the Land Shells. The greater number are found in the N.W. Himalayas, and indicate extension from that direction. Further west, we know nothing of the land-shells of Chitral and the Khyber Hills, the few obtained from the Kuttak Hills and the Kuram Valley are confined to the genera *Petræus*, *Bensonia*, and a *Macrochlamys* very close to *M. Flemingi*. In Afghanistan Palearctic species come in, and in Sind, on the Khojhak range, a *Parmacella* has been found.

We have here reached the limit of the extension of the Zonitidæ, and I will now pass to a review of the genera and subgenera of the Zonitidæ, more particularly concerning what is known up to

¹ Journ. Asiatic Soc. Bengal, vol. xlvii, pt. 2 (1878), p. 148.

² The exact limit of *Alycæus* and of *Diplommatina* west of the Sutlej has yet to be ascertained.

the present of their anatomy, and what value it may be in future classification.

The classification of the Indian Land Mollusca having up to the present been based mainly on such conchological knowledge we possessed, aided by a few external characters of the animals, I have thought it might be of interest, and particularly to the members of this Society, to treat the subject from a malacological point of view. I propose to limit my observations to this large, interesting, and, I believe, very ancient family, the Zonitidæ. Semper, Von Martens, Stoliczka, Simroth, and others have done much excellent preliminary work on the anatomy and external form of the animal in many of the genera described by them, and these authorities I shall quote. The material I have myself obtained, examined, and refer to, may perhaps interest other workers, and, if it does nothing more, will, I trust, extend the knowledge of present distribution, and give perhaps a glimpse of the past history, or phylogeny of some genera and subgenera.

A study of this family extending over many years enables me to show to what extent variation in the internal organs has proceeded in different species, and how restricted such differences are to species within certain well-defined areas. This variation seems to play round certain organs, leaving others unchanged.

In this investigation I have taken cognizance of every character, internal or external, that I found to vary, and it naturally follows that some organs assume a greater prominence than others. I have disregarded the nervous system, for it is a study in itself. Although in the more slug-like forms there may be found considerable modification of the salivary glands, the form of the buccal mass, the coils of the intestine, and the position of retractor muscle attachments, they may well be also treated as specific differences, and at present left alone; nor does the form of the mucous pore assist very much. The value of the arrangement of the intestinal coils in classification has lately been very well exemplified by H. A. Pilsbry and E. C. Vanatta in a paper on a "Revision of North American Slugs,"¹ as well as in a paper on the "Phylogeny of the Genera of Arionidæ."²

I must here quote a paragraph from the above joint paper:³ "Trivial and unsatisfactory as are the external features of slugs, the details of their internal morphology are wonderfully varied. Everywhere there are important characters, and those who starve their souls on a mere study of the genitalia and oral armature miss the best part of the feast." This is true of every family, but it applies more particularly to the Zonitidæ. Valuable material is constantly coming into the country, yet how much of it, only partially examined, is thrown away. The animal is mutilated, the head being severed from the body, and the most interesting organs destroyed

¹ Proc. Acad. Nat. Sci. Philadelphia, 1898, pp. 219-261.

² Ante, p. 94.

³ T. c., p. 219.

merely to extract one single character, the odontophore, which, valuable in one respect, is useless, except when taken in conjunction with all the other characters.

The genus *Macrochlamys*, originally named by Benson from the presence of the peculiar mantle lobes which play over the surface of the shell, being a well-known genus, and the richest in species of the whole family, with an extensive range, I shall take it first, show the modifications the animal presents, and then pass on to other, more or less similar genera. The typical *Macrochlamys* (section A) is a common form in Calcutta, extending thence up the Gangetic Valley, from the Rajmahal Hills to Allahabad, in the north-west Himalaya as far east as Murree, where *M. splendens* is recorded by Theobald. *M. Flemingi* is also found there. A yet undescribed species, allied to this last, I have received from the Kuram Valley. The genus occurs eastward from Darjiling, the Bhutan, Dafia, and Singpho Hills,¹ by the Naga Hills, the plain districts to the south, and away to Arakan and Pegu.

In addition to the presence of shell-lobes on both sides of the body and division of the left neck lobe into two distinct portions, the most noticeable character of the typical form (section A) is to be found in the genitalia. This consists of a coiled, cœcum-like appendage, where the retractor muscle is given off from the male organ. Still, the characters of the typical Calcutta species, *M. Hardwickii*, are not constant over the area I have indicated.

In the Munipur and Naga Hills and North Burma a form is met with, *M. atricolor* (section B), which ranges to Bamao in North Burma. In this the left shell lobe cannot be seen, while, on the other hand, the right shell lobe is enormously developed, and in life must extend right across the shell: the long flagellum of the male organ is reduced to a mere rounded knob. Another departure from the type is *M. Cacharica* (section C). In this the amatorial organ is absent. This variation is not an accidental matter, as some malacologists might suppose, but seems constant in all the specimens I examined, and a similar modification is to be found in other genera of the Zonitidæ, while Pilsbry has noted the loss of this organ in other families with which he has dealt.

Let us turn next to notice two genera, peculiarly distinct in their shell characters from *Macrochlamys*, with its thin, glassy test. These are *Oxytes* and *Bensonia*, with large, solid, often sharply keeled shells. Again, we meet in both with the coiled cœcum from which the retractor muscle springs, and which in *Orobia* is enormously developed. This character, I may point out, I have never seen in any other Indian genus besides these. Whence it is derived, and what its special function may be, I am at a loss to say. *Oxytes* and *Bensonia* possess no shell-lobes to the mantle, but have the left dorsal lobe divided into

¹ The species from these hills remains to be named and described. It is small, of the type of *M. levicula*, and although only 12 mm. in diameter, every character, even to the coiled cœcum, is present. Size, therefore, has little to do with the simplification of the genitalia.

two very distinct and separate portions. There are some minor differences in the radulæ of the different species, but on the whole they appear to me nearer to *Macrochlamys* than to any other genus.

Oxytes ranges from Darjiling (*O. orobia*), the Bhutan Hills, and the Khasi Hills, to Burma and Tenasserim.

Bensonia is represented in the North-West Himalaya by *B. labiata*, and thence ranges to Kashmir and Murree, and in *B. Wynnei* to the arid Kuttak Hills, near Peshawur, and the Kuram Valley. It is thus a North-West Indian genus. I am, however, inclined to think a species like, or near to *B. convexa* occurs at Darjiling, but I have not met with any animal that could be referred to it in the Eastern Hills or in Southern India.

Passing south-eastward towards the confines of the area I have defined for *Macrochlamys*, we find a change commencing in *M. resplendens* (section E), of Tenasserim; we have the shell-lobes still present, but the generative organs are modified in that the coiled mass has gone, and the male organ is more like that of *Hemiplecta* (*Humphreysiana*). In a large Siamese species we find the same features, and I think we are here beyond the range of the Indian type of the genus.

I have failed to find among any *Macrochlamys*-like shells of Peninsular India the exact similarity of anatomical detail so typical of the genus; there are many shells in this part of India which up to the present are included in it, among them being *M. pedina* and *M. platychlamys*, from Bombay. The first-named I include in section D of *Macrochlamys*. It has both the right and left shell lobes, but the former is extremely rudimentary, and judging from analogy and its reduced size in spirit, it cannot be largely protrusible in life. The male organ has become altered in form, its most interesting feature being the replacement of the many-coiled disc by a simple short bend in a cœcum-like process, the retractor muscle rising beyond and above this.

The other species, *platychlamys*, presents far greater diversity when compared with species of *Macrochlamys*. The broad shell-lobes cover the shell almost completely in life, and the generative organs are on a very different plan, and comparatively simple in detail. The examination of the Ceylon shell *regulata* presented anatomical characters of the same type, and I have therefore placed these two species in a new subgenus, *Eurychlamys* (see Appendix). The most interesting fact in connection with this particular development is the discovery that a Sikkim and Bhutan species, *planospira*, must be included with them. I previously placed *planospira*, on account of its shell-lobes and shell (besides not taking into sufficient consideration all the details of its internal anatomy), in *Austenia*, but it will be seen that its anatomy does not at all resemble that of the latter genus.

Continuing the review of the shells of Peninsular India and Ceylon, I have been fortunate in obtaining through various friends, among whom I may mention Dr. Thurston, Mr. Phipson, Mr. W. T. Blanford, and particularly Mr. Collett in Ceylon, other species preserved in spirit, and I am enabled to point out a few details of their general anatomy. They represent six genera, viz., *Ariophanta*, *Nilgiria*,

Euplecta, and the slug-like forms *Africanion*, *Mariella*, and *Ratnadvipia*, a new subgenus (cf. p. 253). The two first genera show so many points in common, that they may be considered very closely allied indeed. *Euplecta* presents certain affinities, yet it may be noticed that in its dorsal lobes there is a departure from *Nilgiria*. All three have very small sessile spermathecas associated with a different form of spermatophore.

Ariophanta has its headquarters in this part of India, but ranges northwards up to the edge of the Gangetic plain, only one species, *A. interrupta*, crossing the delta and occurring in Jessore, seventy miles north-east of Calcutta, although it has never been recorded from further north, or east. As to *A. retrorsa* of Tenasserim and Tavoy, I have always doubted whether it really belongs to this group. I have, however, never had an adult example to dissect, but the radula certainly presents considerable differences. Several Malayan species placed in this genus by Semper differ widely in their anatomy, and must, I consider, be placed elsewhere.

Euplecta is a genus typical of this Peninsula and presenting the greatest development of species in Ceylon. In the details of its generative system it shows a change, and one noticeable at once; briefly stated, a broad muscular band gathers a portion of the male organ together and forms a loop. It possesses also a very small right shell lobe, of about the same size as in *M. pedina*, but no left shell lobe. The very striking form of the spermatophore, so very different from any other with which I am acquainted, is also noteworthy. Very many species were originally placed in this genus of Semper's, yet I believe myself that all foreign to this part of India will finally have to be removed from it. The sculpture and character of the shell are very marked. At present the only species still included in *Euplecta* that await examination are two or three inhabiting Darjiling and the Khasi Hills. These possess so very different a style of sculpture (of which *vidua* may be taken as an example) that I cannot believe they are to be associated with *Euplecta*.

In southern India *Africanion*, represented by *A. ater*, stands alone; no slug-like mollusc hitherto known on the Himalayan, or eastern side can be placed near it. We have to go to East Africa to find one at all similar in its anatomy; it is another interesting example to add to the list of species, pointed out by W. T. Blanford, as having a similar eastern transoceanic connection. It was discovered by Colonel Beddome, and I have not heard of anyone else who has been fortunate enough to find it. Again, *Mariella* is a genus of considerable interest. One species, *M. Beddomei*, was described by me under the subgeneric title *Dekhania*. Gray founded his genus from external characters alone, upon a single specimen in the British Museum, labelled Mahi, which everyone had assumed to be one of the Seychelles Islands. Mr. Cockerell, however, was the first person to associate the name with Mahe on the south-west coast of Peninsular India, and comparison of the type with Beddome's specimens, and some others lately received from Mr. Daly, of Mysore, confirms the identity. It has a very remarkable similarity to *Girasia* of the Khasi Hills: there are

differences in the radula and jaw, and in the shell, which the mantle lobes cover to a greater extent; these divergences are only such as might be expected when the great extent of country intervening is considered. Our member, Mr. Webb, has lately re-examined this genus and confirms my original views. I have also, when lately working out the retractor muscle system of *Girasia*, examined that of this southern genus also. The agreement is very great; no difference either is to be found in the form of the spermatophore.¹

I would here make a few remarks on these curious and beautifully formed structures; they have not received the attention they demand in classification, except from a few biologists. In looking at the modification and intricate details they present, we are brought to consider the vast interval of time it must have taken to effect changes in any group of animals, particularly in the mollusca; the thousands and thousands of years represented by the Tertiary Period does not seem enough for this evolution. How vast it becomes when we try to reconstruct the form of the spermatophore in the Zonitidæ before they began to branch off one from the other! We see that in the case of such an excretory instrument as a spermatophore any change in the proportions or details of its different parts, is the result of modifications that have taken place in the interior of another organ within which it is moulded, and, again, a proportionate change in that of another organ, the spermatheca, within which it comes to finally rest. When we are trying to extend our knowledge of geographical distribution we cannot be too particular, or afford to neglect any morphological details that are presented to us. While a great deal of small minor variation has gone on, in a broad sense quite recently, in the form of the shell, in its sculpture, etc., there has not been, on the other hand, so great an amount of what constitutes true generic change. In this family of the Zonitidæ, as represented in India, the spermatophore illustrates this. Only four well-marked and specialized types have been noticed by me, up to the present, occurring in the genera: (1) *Macrochlamys*; (2) *Ariophanta* and *Nilgiria*; (3) *Girasia* and *Austenia*; (4) *Euplecta*; this last being the most differentiated. These structures will accentuate the value of certain main groups when the time comes to decide upon them. There is, however, an enormous amount of material to be examined, and until this is done we should hold back from the creation of these divisions and subdivisions, at which there is a great tendency to play, and occasionally we see no attempt made to describe the particular characters that mark off one division from another.

It truly comes to this, the examination of the spermatophore of every species among the Zonitidæ would be far more satisfactory than that of the muscular tube that surrounds it, for in the spermatophore we have reached the end of a stage of development, the resultant of original birth and existence about to begin again,

¹ The restoration of this from broken portions, figured by Mr. Webb (ante, pl. ix, fig. 6), is not by any means true to nature.

which goes no further. The form of the interior or mould depends much on the stage of development reached by the spermatophore, and this modifies the external outline. I do not think this is sufficiently taken into consideration by certain malacologists, who are given to see in some genera of the mollusca they are studying differences which to them are specific, but which truly are extremely slight variations in the external outline of the reproductive organs.

Returning again to geographical distribution, I have to notice another form inhabiting Ceylon, viz. the *irradians* of Benson, for which I cannot find a prototype. In its jaw and radula there are interesting differences as compared with other species, and its reproductive organs are far simpler than one might have expected. The tentacles are nearly white in spirit specimens; in life I believe they are yellow. On these grounds I have had to create a new subgenus, *Ratnadvipia*,¹ for its reception.

Smaller species from this part of India will be alluded to further on.

I now pass on to genera occurring in Burma and the Malay Peninsula, etc. First in importance comes *Hemiplecta* of Singapur (the type being *H. Humphreysiana*), a genus which has suffered much from the lack of adequate definition of its characters, and on the ground of shell character alone has either been made the receptacle for forms from Peninsular India, or been itself merged in the genus *Rhysota*. This was Stoliczka's course when he placed *H. Cymatium* of Penang in *Rhysota*. It agrees in every particular with *H. Humphreysiana*. In the presence of shell-lobes on both sides, in the radula and generative organs, it is quite unlike any South Indian form. This genus, represented by *H. densa*, extends to Borneo, and includes several other species in that very distinct province of Malayana.

Cryptosoma as a subgenus is represented by several large species from Burma, Siam, etc. The points that distinguish this from kindred forms are not many; there is scarcely any change in the generative system, in its general outlines, but the spermatophore is armed with spines, while such are absent in *Girasia* and *Austenia*. The jaw and radula differ altogether, as the formula of the latter shows. It has lately been claimed that this genus is found in Calcutta, and Mr. Collinge has described and figured a small species and named it after me. Unfortunately, all description of the jaw and radula is omitted, and I should expect the number of teeth in the row would have conformed to *A. Bensoni* had they been examined, while the genitalia figured were not quite complete. The shell is remarkably like *A. Bensoni*, which is fairly common and well known in Calcutta.

I would add a word or two of warning concerning Calcutta species. Many circumstances conspire there to promote the introduction of foreign species. The extensive Botanical Garden is a good place for shells, and consignments of plants are constantly being received there from every part of India and of the world, so that a transported shell might very well become established, and spread far and wide, as some have done in this very locality.

¹ One of the old names of Ceylon: *ratna*, 'a jewel,' and *dvipa*, 'an island.'

In speculating on the distribution of land-shells, this casual picking up and transport by man's agency is an element we have always to consider. One means of transport lies in the thatch of the native craft plying on the great rivers of India. Thatched boats coming down from Assam, Cachar, and Sylhet work all through the delta to Chittagong, and even down the coast at times. This was brought home to me very practically on one occasion when crossing the Bheels of Sylhet during the rains. We were poling through the high reeds, when I noticed they were covered with *Helix* (*Planispira*) *similaris*, of which I collected a good number of very fine specimens. In such a place, even if they fall in the water, blown off by the wind, they would soon get on to the reeds again, and thus survive until the floods abated; but how easily they would be knocked off into or on to the thatch of a boat, and be carried down to the sea margin! The species has an enormous range, and this may be one of the means by which that has been brought about. Minute species may have been transported in fruit, such as melons, and especially the banana, and in vegetables, by the same agency of native vessels, which have been navigating the Eastern seas for hundreds and hundreds of years, perhaps long before our knowledge of ancient Egypt begins.

Coming to the North-East Frontier and Burma, *Girasia*, and the closely related subgenera *Austenia* and *Ibycus*, have, perhaps, as extended a range as any of the Indian land mollusca. These subgenera are associated in the typical locality, the Khasi Hills, whence Sir Joseph Hooker first sent home *Girasia*, throughout Assam, the foot of the Eastern Himalaya, westward to Sikkim, and in the North-West Himalaya from Gurlwal to Chamba as far as Murree. They are found also from North Burma to Pegu and along the Siam border. The giant of the race, *A. magnificus*, was discovered by Dr. J. Anderson in Yunnan. I have not yet seen any species from Siam proper, nor from the Andaman Islands.

The slug-like form finds its fullest development in *Girasia rubrum* (assuming it to belong to this genus) of the Naga Hills. In this species the shell has become reduced to a minute thin oval disc, and there is truly here as great a difference, comparing it with *Girasia*, as there is between this last and *Austenia*. I have no doubt that similar molluscs will be found in other parts of India if only they are sought for.¹

Species of *Girasia* are found inhabiting the plain country of Assam, as well as the mountain ranges up to 5,000 and even 8,000 feet; they are not, like so many other species, tied as it were to rocky ground, and this may account for their very general distribution. I have pointed out that one form of the genus occurs in Peninsular India. They rejoice in damp; the complete saturation point is the one best suited

¹ In such a series as this we are compelled to give the shell greater weight in classification than it otherwise would deserve, and supposing by any possibility such forms as these were preserved in a fossil state, such a course would be strictly right, and prove the most useful for purposes of identification.

to their existence. Thus they are to be seen at their best development in the rainy season, and I believe these moist conditions have played no small part in their evolution, by the stimulus they have given to the expansion of the shell-lobes. When kept in captivity they do not live long; the mantle shrivels up and exposes the shell more and more daily, the bright and glistening surface of the body becomes first dull and then covered with fungoid growth and sores, under which the animal succumbs.

There is yet another section of mollusca with thin, poorly developed shells, which are concealed, like those of the genera I have already spoken of, beneath ample shell-lobes. This section is represented by the genus *Durgella*, first known as a native of Tenasserim, and it possesses very distinctive characteristics of its own. Its principal points of divergence from *Girasia* and its allies are found in the feeble, straight jaw, and large broad radula, with minute central tooth and an immense number of serrated teeth, all similar in shape, in each row, while the generative organs are simple. Since Mr. W. T. Blanford described the genus, species have been discovered in the Khasi Hills, in the Assam Plain, one in the Andamans, one in Peninsular India, and one far away in Borneo. It has thus a very remarkable range. No close relationship has yet been found between it and other forms; save perhaps with *Kaliella*, which it resembles in the form of the lateral teeth of the radula. *Durgella*, therefore, may perhaps represent a primitive race that has nearly died out, but it is yet possible that further research may reveal other forms with which it can be associated.

Kaliella has a very interesting range. Starting with Kashmir, it is found along the whole of Northern India, at or near the base of the hills, in the plains, in Assam, Burma, Southern India, and Ceylon, and I have even received it from Madagascar. *Sitala* is hardly less circumscribed in its range. The two genera are in certain points allied anatomically, but it is noteworthy that *Sitala*, as shown by Stoliczka, has one section, represented by *S. infula*, in which the amatorial organ is absent, and the teeth of the radula are very numerous.

I have now brought to your notice the majority of Zonitoid genera the animals of which have been examined.

Microcystina is an Andaman form, and if the shell can be trusted occurs in Ceylon and Borneo, but better material from these lands must be worked over again.

Sophina, described by Stoliczka, is a very distinct genus, peculiarly local, confined to Tenasserim and southwards to the Malay Peninsula, and not extending to the north. *Xesta* is a well-marked Malayan group, so is *Rhysota*. *Parmarion*, *Microparmarion*, and *Damayantia*, Simroth has shown to be genera very distinctive in themselves, and inhabitants of Java and other islands, as well as Borneo. In *Microcystina*, numerous small forms have been placed, apparently because there was no other genus open to receive them; it no doubt will break up into several very distinct divisions, and leave *Microcystina* proper to the islands of the Pacific. You will, I think, agree with me that this investigation may be said to have only been begun. There is a vast amount of work

to be done: in the Andaman Islands, for instance, there is a group of *Macrochlamys*-like shells represented by *choinix*: we know from dried-up animals that shell-lobes are present, but we have yet to learn to what section of the above genus they belong. *Hemiplecta Haughtoni* is another large species concerning which we know nothing for certain. In Southern India there is *M. ? ampulla*, also the large species *II. ? basileus*, of which the same may be said. When we come to the smaller fry, they are too numerous to mention, and we do not know what further research may show. No better example of this can be quoted than the discovery by Mr. Collett in Ceylon of a form belonging to the Endodontidæ, for which I founded the genus *Philalanka*,¹ and I may here put on record that a very closely allied species was lately sent me by Mr. Stanley Flower from the Batu Caves, near Selangor in the Malay Peninsula. The examination of this animal so interested Mr. Pilsbry that in a letter he writes: "This is to me the most interesting addition made for years to the fauna of Ceylon and India. I believe, however, there can be no doubt of the soundness of your conclusions as to the affinities of the little fellow." I quote this because, as we are all so liable at times to come to wrong conclusions, it is confirmatory (of course, subject to the correctness of my drawings and description) of the position of this mollusc. There are several other small shells from Ceylon of equal interest, such as *Pupa miccylla*, which I cannot believe is a *Pupa* at all.

The outcome of what I have said and feel is this: a great deal more has to be done, and I hope this Society will be the means of helping to do it. It will never be completed as it should be, until some malacologist goes out to work in the country, and on fresh material. There should be an examination in the typical habitats of species which Benson and others described long ago. At the same time other species would be made known, for which only a trained naturalist knows how and where to look.

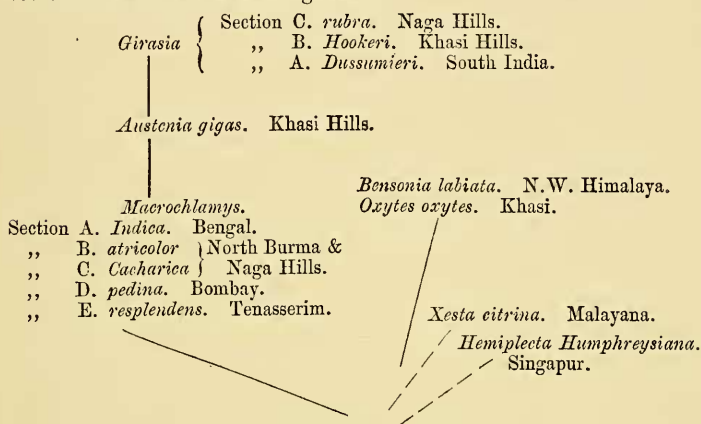
Pilsbry, in "The Phylogeny of the Arionidæ," says: "As a whole, the Arionidæ not only do not possess the characters of primitive shell-less forms, 'Unbeschaligkeit,' but the series of recent genera unmistakably indicates their descent from a group with well-developed spiral shell."² How much more distinctly is similar evolution exemplified in this section of the Indian Zonitidæ. Between *Macrochlamys* and *Girasia* forms are to be found wherein the chief successive differences consist in a less developed shell and greater developed shell-lobes. In this series anatomical details at last become more of specific than of generic account, and it is most instructive to follow, as the original spiral visceral mass becomes a simple bag, the gradual concentration backwards under the shell-lobes of the branchial cavity, with the heart and kidney in the anterior part, while the liver lobes, intestine, albumen gland, hermaphrodite duct, and ovotestes follow on the posterior side, and finally the complete isolation in a cavity of its own, of a quite rudimentary shell, as in *G. rubra*. This is sufficient

¹ Ante, p. 11.

² Ante, p. 99.

to show there is something more than an indication that *Girasia* is the more recent development, and the same line of reasoning points to *Macrochlamys* being relatively in turn the more primitive genus. It is not so easy to locate *Oxytes* and *Bensonia*; the probability is that they started like *Macrochlamys* from some no longer existing form, and have had a cotemporaneous development with *Macrochlamys* itself.

The following diagram is a graphic representation of the possible succession of a few of these genera:—



When one examines the genera from South India and Ceylon, one cannot but fail to be impressed with the many important points in their anatomy, which differentiate them from genera of the same family occupying other parts of India. Without enumerating the many genera and species of other families which are quite peculiar and restricted to this Peninsula, the number of genera I have brought to your notice in this address is large and characteristic of isolation. Nor is this more than might be expected, as the result of the past conditions over a considerable part of this area. The geological evidence indicates that this part of India is one of the oldest of land surfaces on the globe. Ever since the east and west Cretaceous oceans washed its shores, the fringing line of which is preserved at different points, some part of it at least remained dry land. Very similar conditions appear to have existed during Nummulitic times, and not until the advent of the Eocene does there appear to have been any connection with Palæarctic lands and fauna on the north-west. With the deposition of the Nahan series of deposits in a gradually sinking belt, under conditions which, there is every reason for supposing, were alluvial, not far from and just keeping above the sea-level, a broad dry land connection was established. We may imagine the great alluvial plain of Maimensing and Sylhet, between the line of mountains and the sea, to be representative of such conditions there; for there may be seen the piling up of similar deposits of

sandy beds without a pebble in them. During Cretaceous times and afterwards there is evidence of the connection, perhaps by an isthmus, with the North-East Himalayan area, across the present Gangetic Delta, the line of coast lying then on the north side of the present more recent elevation of the Khasi Hill range. All this, briefly stated, supports the possibility that the genera and species of to-day are the direct descendants of the molluscan fauna of a very early time, and the survivors of many changes. How far they have been modified, how old some may be, only the evidence of fossil forms can show. I here revert to remarks made at the commencement of this address, on the importance of trying strenuously to find some of these fossil representatives, and, if possible, arrive at what has been the extent of the changes and in what direction. Evidence exists, but as yet it has been superficially worked. Take, for example, the Cretaceous fossils, which are far too ancient for us to expect that any very close resemblance with the present forms would be shown; yet only four species of *Helix* have been found in South India;¹ probably this is not a quarter of what may be preserved.² Coming to the inter-Trappean beds and the Tertiaries, patient search will no doubt be rewarded—it cannot fail to be—with an addition to the number of fossil land-shells of the very greatest interest and value. What we want to know is at what period and to what extent changes in the molluscan fauna of India have taken place. Mr. W. T. Blanford has dealt with this inquiry, and on the evidence of what has been hitherto found writes:—³ “All the forms known from the Upper Siwaliks, with one exception, are recent species of land and fresh-water shells now living in the area. Of *seven* fresh-water mollusca⁴ found associated with the Lower Siwaliks, none appears to be identical with any living species, and only two are allied, one closely, the other more remotely, to forms now met with in Burmah, 30° of longitude further east. . . . One-third of the species of mammalia survived the changes that took place, whereas not a single mollusk is found both in the Upper and Lower Siwaliks.”

In conclusion, let me say how exceedingly glad I am that my old and very good friend for so many years follows me in this chair. The Mollusca were an old love of his long ago, and he will, I hope, at some future meeting, favour us with his views on their distribution, which his great knowledge in other orders will enable him to treat of more fully than I have done.

¹ These are three species of *Anchistoma*, having the character of *Covilla* or *Plectopylis*, the first restricted to Ceylon and one species put in *Macrocyclus*.

² These land-shells are from deposits on the margin of the old Cretaceous coastline, and others may be looked for in similarly situated deposits of that age. On the Garo-Khasi boundary, for instance, λ 25·25, on the Trigonometrical Station of Lumdekor, an outlier, a good section is to be seen. The pale-coloured, fine silty deposits were full of the most beautifully preserved plant remains I have ever seen, indicating the proximity of a forest-clad land.

³ Rec. Geol. Surv. Ind., vol. xviii (1885), p. 38, pl. i.

⁴ Mem. Geol. Surv. Ind., vol. xx, pt. 2, p. 129.

APPENDIX A.

LIST OF SHELLS FROM KASHMIR TERRITORY, NORTH OF THE
PIR PANJAL AND KAJNAG RANGES, INCLUDING YARKAND.

1. *Macrochlamys Austenianus*, Nevill. Sonamurg, Kashmir (Stoliczka), south of the Zoji La. This seems to be a dwarf form of *M. Flemingi*.
2. (*Macrochlamys*?) *Kashmirensis*, Nevill. Sonamurg, Kashmir (Stoliczka), south of the Zoji La.
3. (*Microcystis*?) *Sonamurgensis*, Nevill. Sonamurg, Kashmir (Stoliczka), south of the Zoji La. Stoliczka noted that the animal possesses a mucous pore.
4. (*Thysanota*?) *hyba*, Bs. Aijas, east of the Walur Lake, Kashmir (Theobald). Theobald also records this species from between Chamba and Dalhousie. The typical locality is the sub-Himalaya, near the Sutlej River. Should the animal of this species eventually be found to be similar to *erinigera* of Southern India, it will have to be transferred to a genus of the Helicidae, for an examination of the latter species shows that *erinigera* possesses a pointed heliciform extremity to the foot.
5. *Kaliella Barrackpurensis*, Pfr. ? Kashmir Valley. Whether this single specimen was found in the valley, or outside, is not stated. Theobald's title to his paper says "more particularly of the Jhelum Valley and the hills north of Jamu," which is sub-Himalayan. The height of this specimen is given as 6 mm. This must be either an error in measurement, or it is another species, for I have never seen, among hundreds of specimens, any approaching this size.
6. *Hyalina fulva*, Drap. Mataian (Stoliczka), north of Pir Panjal (Theobald); also from Spiti and Láhul (Stoliczka).
7. *Hyalina lucida*, Drap. North of Pir Panjal (Theobald).
Whether any anatomical differences exist between the Kashmir and European forms of *Hyalinia* has yet to be discovered.
8. *Vitrina pellucida*, Müll. Mataian, Dras. North of Zoji La (Stoliczka). I think this will prove to be a distinct species. The animal of the European form is pale in colour; Stoliczka records that of Kashmir as "blackish, with the tentacles short." He also obtained it in Láhul.
9. *Hygromia hispida*, Linn. Skardo, Baltistan (Godwin-Austen). None of these shells collected by me at Kuardo in Skardo were found living; they were sub-fossil in an alluvial deposit near the Indus River, probably of Interglacial age.
10. *Eulota Mataianensis*, Nevill. Mataian, Dras.
11. " *Huttoni*, Pfr. "Widely distributed" (Theobald).
12. *Vallonia costata*, Müll., var. "Large and finely ribbed." Skardo, Baltistan (Godwin-Austen).
13. *Vallonia costata*, var. *Asiatica*, Nevill. Yarkand (Stoliczka).
14. " *Ladacensis*, Nevill. Mataian, Dras; Leh, Ladak.

15. *Vallonia pulchella*, Müller. Skardo, Baltistan (Godwin-Austen).
16. *Eulota phaeozona*, V. Martens. Yarkand (Stoliczka).
17. „ *plectotropis*, V. Martens. Yarkand (Stoliczka).
18. *Helicella Stoliczkana*, Nevill. Yarkand (Stoliczka).
19. *Petræus candelaris* = *domina*, Bs. Kashmir Valley (Theobald); Nishat Bagh (Godwin-Austen). Extends to Murree, etc.
20. *Petræus arcuatus*, Hutton. Kashmir (Theobald). Extends to Simla.
21. *Petræus Stoliczkanus*, Nevill. Sonamurg.
22. *Pupa eurina*, Bs. Skardo (Godwin - Austen). The typical specimens were found in the exuvia of the River Gogra at Tribeni Ghat. This river rises in the Tibetan plateau, and these shells may have been brought down thus from far back in the mountain range.
23. *Pupa (Pupilla) muscorum*, Linn. Pangkong Lake, Ladak, and Yarkand.
24. *Zua lubrica*, Skardo (Godwin-Austen).
25. „ *cristata*, V. Martens. Yarkand (Stoliczka).
26. *Succinea Pfeifferi*, Rossm., var. *Yarkandensis*, Nevill. Yarkand (Stoliczka).
27. *Succinea Pfeifferi*, var. *subintermedia*, Nevill. Also from Kandahar (Hutton).
28. *Succinea putris*, Linn.¹ Skardo (Godwin-Austen).
29. „ „ var. Yarkand (Stoliczka); Kandahar (Hutton); Calcutta.
30. *Succinea oblonga*, Drap.¹ (Godwin-Austen.) Kashmir (G. Nevill, by Museum collector).
31. *Succinea Martensiana*, Nevill. Yarkand (Stoliczka).
32. „ *Indica*, Pfr. Kashmir (Stoliczka).
33. *Limnæa peregra*, ? Müll. Skardo (Godwin-Austen).
34. „ *palustris*?, Linn. Skardo (Godwin-Austen).
35. „ *lagotis*, Schr. Pangkong Lake.
36. „ *auricularia*, Linn. L. Sirikul, Pamir.
37. „ *Deflippii*, Iss., var. *Sirikulensis*, Nev. L. Sirikul, Pamir.
38. „ *lagotis*, var. *Yarkandensis*, Nev. Yarkand.
39. „ „ var. *subdisjuncta*, Nev. Leh.
40. „ „ var. *costulata*, Nev. Leh.
41. „ *Andersoniana*, Nev. Yarkand and Yunnan.
42. „ *truncatula*, Müll. Skardo (Godwin - Austen), Leh (Stoliczka).
43. *Limnæa Lessoni*, Issel. (Persia) Pamir Kul.
44. *Planorbis (Gyraulus) albus*, Müll., var. Leh, Pangkong Lake, Yarkand.
45. *Planorbis (Gyraulus) lævis*, var. *Ladacensis*, Nevill. Leh.
46. „ (*Tropiodiscus*) *subangulatus*, Phil., var. Yarkand.
47. „ (*Segmentina*) *nitidus*, Müll. Yarkand.
48. „ (*Hippentis*) *complanatus*, Linn. Yarkand.

¹ I doubt the identification of these two species; the animals of species in this genus have not been well and thoroughly examined. Its accomplishment might show very much that may be of better specific value than the shells present us with.

49. *Planorbis (Armiger) nautileus*, Linn. Yarkand.
 50. " " *nanus*. Skardo (Godwin-Austen).
 51. *Bythinia pulchella*, Bs. Kashmir Valley (Theobald).
 52. *Valvata piscinalis*, Müll. Pangkong Lake, Sopur (Theobald).
 53. " *Stoliczka*, Nevill. Yarkand.
 54. *Corbicula Kashmirensis*. Jhelum River (Theobald).
 55. " *occidens*, Bs. Jhelum River (Theobald).
 56. *Spharium Indicum*, Desh. Quoted by Theobald. Exact locality not given.
 57. *Pisidium obtusale*, Pfr. Pangkong Lake (Stoliczka).
 58. " *hydaspicola*, Theob. Shupiyān, Kashmir Valley (Theobald). This stream is a tributary of the Jhelum, flowing from the northern slopes of the Pir Panjal.
Pisidium. Species not identified. Skardo (Godwin-Austen).
 ,, Three species unnamed by Nevill. Yarkand (Stoliczka).

APPENDIX B.

LIST OF SHELLS FROM KASHMIR TERRITORY, SOUTH OF THE PIR PANJAL AND KAJNAG RANGES, INCLUDING THE MURREE HILLS AND HAZARA.

(LAND SPECIES.)

1. *Ennea bicolor*, Hutton. In outer hills, near plains.
2. *Macrochlamys splendens*, Hutton. Tinali (Stoliczka). Spirit specimen described by me was supplied by Theobald as from Murree.
3. *Macrochlamys splendens*, Hutton. Uri, Jhelum Valley (Theobald). I doubt the identification. Theobald says "like *aspides*" (which is a Tenasserim shell), "lip thickened inside as in *Bensonia monticola*."
4. *Macrochlamys*, near *prona*, Nevill. A single specimen from the outer hills, exact locality not given (Theobald).
5. *Macrochlamys*, near *prona*, Nevill. Young shells, Murree (Stoliczka).
6. *Macrochlamys patane*, Bs. Uri (Theobald). I doubt very much this extension of a Darjiling species so far to the westward, and it has not been recorded from the well-worked N.W. Himalayan area.
7. *Macrochlamys*, species resembling *levicula*, Bs. Uri (Theobald). Impossible to say what this may be, but it is very unlikely to be a *Durgella*.
8. *Macrochlamys Flemingi*, Pfr. Jhelum and Chenab Valleys, and Murree (Theobald), Tinali (Stoliczka).
9. *Macrochlamys Austenianus*, Nev. Tandiani (Theobald). This is the young of the preceding species, not the form found at the head of the Sind Valley.

10. *Macrochlamys cassida*, Bs. Uri, Jhelum Valley (Theobald).
 11. *Austenia Theobaldi*, Godwin-Austen. Bichlari, Chenab Valley (Theobald).
 12. *Austenia scutella*, Bs. Nasmana, Chenab Valley (Theobald).
 13. *Bensonia monticola*, Hutton. Chenab Valley (Theobald).
 14. " " var. *Murriensis*, Nevill. Changligulli, near Murree (Stoliczka).
 15. *Bensonia Jamuensis*, Theobald. Tawi Valley (not "Jawi"), near Jamu (Theobald).
 16. *Bensonia angelica*, Pfr. Uri (Stoliczka).
 17. " *Jacquemonti*, V. Martens. Murree (Stoliczka).
 18. " (?) *chloroplax*, Bs. Murree (Stoliczka). Extends to Simla.
 19. *Microcystis? Nevillianus*, Theobald. Tandiani (Theobald).
 20. *Thysanota Tandianensis*, Theobald. Tandiani (Theobald).
 21. *Trochomorpha?* near *hyba*, Bs. "The animal has a distinct overhanging mucous pore."—*Theobald*.
 22. *Kaliella fastigiata*, Hutton. Tandiani (Theobald).
 23. *Anadenus altivagus*, Theobald. Changligulli, near Murree (Theobald). This genus ranges to Sikkin.
 24. *Pyramidula humilis*. Tandiani and Murree (Theobald). Ranges to Simla and Mussoorie.
 25. *Peronæus Nevillianus*, Theobald. Tandiani (Theobald).
 26. *Buliminus (Petræus) Mainwaringianus*, Nev. (Stoliczka.)
 27. " " *Beddomeanus*, Nev., vars. *typica*, *turrata*, *pusilla*. Tandiani (Theobald).
 28. *Buliminus (Petræus) pretiosus*, Cantor. Tinali (Stoliczka), Kathai Fort, Jhelum Valley (Theobald).
 29. *Buliminus (Petræus) domina*, Bs. Murree (Stoliczka).
 30. " " Dextral var. Abbottabad (Theobald).
 31. " " *Smithii*, Bs. Uri and Murree (Theobald).
 32. " " *candelaris*, Pfr. Tinali (Stoliczka).
 33. " " *Sindicus*, Bs. Kohala, near Murree.
 34. " " *rufistrigatus*. On the outer hills (Theobald).
 35. *Pupa*, like *plicidens*. Jhelum Valley (Theobald). Not described.
 36. *Pupa Himalayana*, Bs. Jhelum Valley and Pir Panjal; also from Naini Tal, Mussoorie, and Simla.
 37. *Pupa Huttoniana*, Bs. Jhelum Valley. Is a South Indian form. Since Theobald says it has been "carried down during floods into the plains," he alludes, I presume, to the south side of the Pir Panjal range.
 38. *Clausilia (Phædusa) Waagani*, Stol. Below Baramula (Stoliczka).
 39. " " *cylindrica*, Gray. Tandiani (Theobald), Murree (Stoliczka). Ranges to Simla and Naini Tal.
 40. *Opeas gracilis*, Bs. In outer hills, near plains.
 41. *Geostilbia balanus*, Bs. In outer hills, near plains.
 42. *Cælostele scalaris*, Bs. In outer hills, near plains.
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